Vol. V. JULY, 1888. No. 3.

AMERICAN METEOROLOGICAL JOURNAL.

A Monthly Review of Meteorology, Medical Climatology, and Geography.

TABLE OF CONTENTS.

ANN ARBOR, MICH., U. S. A.:

METEOROLOGICAL JOURNAL COMPANY.

19, 21 and 23 Huron Street.

F. A. BROCKHAUS, Leipsic, Berlin, and Vienna, Agent for German and Austrian States.

Single Copies, 25 cents. Per Annum, $2.00. In European Countries, $2.25.

Entered at the Ann Arbor Postoffice as Second Class Matter.

THE AMERICAN
METEOROLOGICAL JOURNAL.

VOL. V. ANN ARBOR, JULY, 1888. NO. 3.

ORIGINAL ARTICLES.

A NEW WIND VANE.

BY W. A. GLASSFORD.

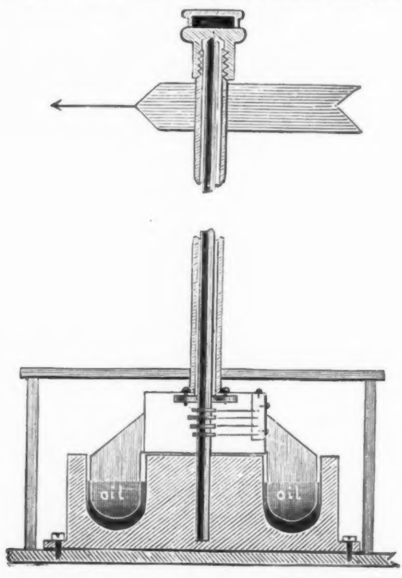
The California State University at the instance of President E. S. Holden and Prof. Frank Soulé, in 1886, purchased through the Signal Service, standard instruments for use at the Meteorological Observatory in Berkley. They having only a limited amount of money to expend upon the observatory it was not possible to pay the price of a large vane.

The writer was requested to design and has made a simple and less costly one than the Signal Service standard, yet fulfilling all its requisites.

A vane as illustrated in the accompanying cut, with a few changes, was the result. This design is believed to possess a few advantages worthy of note; the most novel being the idea of supporting all the weight upon a point like a compass card, the friction rollers with vertical instead of horizontal axes and not bearing the weight of vane, also an oil pot into which dip paddles connected to vane to lessen the suddenness of vibration and at the same time offering no resistance to gradual and easy movement.

The arrow and tail may be of any design or size and fixed to a metal pipe or tube at right angles. The flat sides of vane must be in same plane with axis of tube. To one end of tube, or hollow rod, near which vane is fixed, a metal cap is provided

which is screwed over end of tube an inch or more. A metal rod somewhat smaller in diameter than the inside of tube is firmly fixed, preferably to a metal base, and placed vertically in the roof or at the location of the desired exposure. The rod should be steel-pointed at its upper end, and a trifle longer than the tube. The tube, vane and cap end up, is now placed over the pointed vertical rod and when lowered the point of rod pro-



jects a trifle above the end of tube. The cap is now screwed over point and on end of tube. The pointed rod and inside head of cap come in contact and if screwing the cap is continued the whole tube, with vane attached, will be lifted and supported by end of pointed rod. The inside head of the cap must be of steel, agate or something that will admit the friction of the bearing, incident to the weight, without cutting it, and being concave the tube or pipe with vane and fixtures is poised upon the point of rod, the friction surface being reduced to this single point and the horizontal friction rollers near bottom of tube shown in cut. These friction rollers or wheels not bearing any

weight are subject to the simple friction of revolution as the wind changes, or the force of the wind against outside of tube and the vane. The vane and its parts should be so constructed that the weight is accurately poised upon the point of rod.

The cap is provided with a fixture to keep it from unscrewing, and also with an oil well.

At the bottom, the tube is enlarged and inside are placed the horizontal friction rollers or wheels, also the apparatus for making the connections to an electrical self-register, quite similar to the usual means employed.

Near the bottom also are placed flat paddles in same plane with axis of tube and which dip into a circular oil pot formed in the metal base which holds the rod vertical. The oil offers no resistance except to violent swinging of the vane, which it is intended to prevent, and the result is freedom from any vibration but motion in response to actual changes of wind direction only.

If it is deemed essential to record the direction of wind by a dial on the inside of building no difficulty arises when a cogged wheel is set on the outside of tube and a cogged wheel of same diameter is used with a universal joint.

A wooden base, that can be opened, surrounds the lower portion of the tube covering the plate and attachments on the roof at bottom of tube.

Essentially the same vane as above described is now in operation at the observatory of the State University of California at Berkley near San Francisco, and gives much satisfaction.

THE NEW SWISS METEOROLOGICAL OBSERVATORY ON THE SENTIS (8,200 ft.)

BY A. LAWRENCE ROTCH,

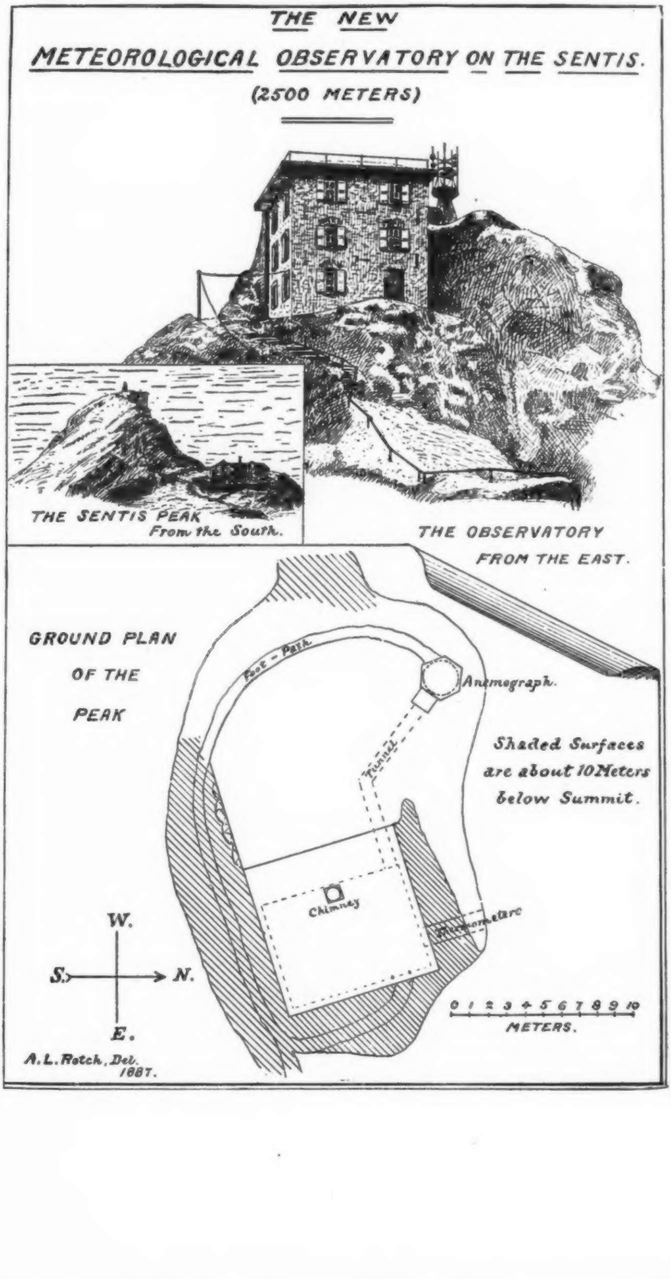
Member of the German Meteorological Society, and Fellow of the Royal (London) Meteorological Society.

History of the Station.—The Sentis, the highest mountain in the canton of Appenzell, in lat. 47° 23′ W., long. 9° 28′ E. and 2,500 m. above the sea, was the point recommended by the International Meteorological Commission for a meteorological station. It was established in August, 1882, through the efforts of Director Billwiller of the Swiss Central Meteorological Office

aided by subscriptions and by an appropriation from the Federal Council. The station was located in the wooden inn northeast of, and about 40 m. below, the summit upon which an anemograph was erected. The station as it appeared in August, 1885, was described in the JOURNAL, Vol. II, No. 11.

At the end of the third year's work of the station the Federal Council, convinced of its practicability and usefulness, assumed the cost of maintaining it by increasing the budget of the Central Office. About the same time, through the legacy of Fritz Brunner, the Office received 125,000 francs, part of which it was decided to apply to building an observatory upon the actual summit of the Sentis. There were several reasons why this was desirable. On account of its frail construction and the crowds of visitors in summer the inn was constantly in vibration which affected the readings of the barometer. Also, the sheltered situation of the inn gave different values for the other elements from those obtainable on the freely exposed summit, though the anemometer there was often inaccessible in stormy weather. A building could not be placed upon the extreme summit because there was insufficient room, and it was necessary to keep the view open to tourists. Accordingly, it was decided to excavate the northeast side of the rocky peak for the observatory, which is thus sheltered against the violent west winds. The building was commenced early last summer, the necessary blasting having been completed in the autumn of 1886, and was inaugurated October 3–4, 1887, when Director Billwiller and the writer were the first persons to pass the night in it.

The Building.—The new Observatory is a three-story building substantially constructed of the excavated limestone. It backs against the peak and has a flat roof nearly level with the summit, which is surmounted by the anemograph. By means of retaining walls the summit has been extended so as to join the roof, leaving, however, an air space between the retaining wall and the rear wall of the house. The Observatory is 8 m. wide, 6 m. deep and 9.3 m. high. The ground floor contains the telegraph office, observer's room, kitchen and store-room; the second story, living and bed-rooms for the observer and care-taker; and


THE NEW
METEOROLOGICAL OBSERVATORY ON THE SENTIS.
(2500 METERS)
THE SENTIS PEAK
From the South.
THE OBSERVATORY
FROM THE EAST.
GROUND PLAN
OF THE
PEAK
Foot-Path
Anemograph.
Tunnel
Shaded Surfaces
are about 10 Meters
below Summit.
Chimney
Thermometre
W.
S.
N.
E.
0 1 2 3 4 5 6 7 8 9 10
METERS.
A. L. Rotch, Del.
1887.

the third story, living and bed-rooms for visiting scientists and a spare room. The walls of the building are 0.5 m. thick, laid in cement, with a space between the stone and the sheathing which, like the double lower floor and the roof, is filled with felting, etc. The windows are double, and are provided with outside wooden shutters. The heating is by stoves in each story, one stove burning about 5,000 lbs. of coke during the winter. They communicate with one chimney, surmounted by a copper cowl. This, together with the metal gutters, etc., is connected with the lightning conductors around the anemometer. A tunnel from the third story to below the anemograph hut gives access to it by means of a vertical shaft with a ladder.

On the flat gravelled roof of the Observatory can be installed the sunshine recorder, and also the rain gauges, if the situation is not found too windy. The thermometers are exposed at present from a northwest window of the third story, but on account of the influence of a neighboring mass of rock the shelter will probably either be extended beyond the rock or the rock itself removed.

Cost and Maintenance of the Observatory.—The cost of the new building, including furniture, has been about 60,000 francs. The cost of maintenance is estimated at 6,000 francs annually. The observer for several years has been C. Saxer, who receives 2,000 francs salary and free board. During the winter he has with him a care-taker and his wife. Communication with Weissbad, a village at the base of the Sentis, is had by telegraph and several times during the winter by messengers.

The Instruments and Observations.—The instrumental equipment of the new Observatory at its opening was the same as was described in detail before, and is briefly as follows: On the highest point of the mountain is a Beckley anemograph, similar to that used at the stations of the English Meteorological Office, which registers the velocity and direction of the wind. The frost-work, which has frequently interfered with its action in the past, can be removed now that the apparatus is easily accessible. The standard barometer and the Hottinger aneroid barograph have been placed in the second story of the new building,

at an elevation of 2500 m., which is 33 m. above their former position. There is no thermograph, but the night temperatures are obtained from the turn-over thermometers of Negretti and Zambra. By means of these and of the eye observations the temperatures have been obtained since July, 1884, each two hours, from which values the maxima and minima are derived. The rain gauges and Wild wind-vane and pressure-plate at the inn had not been re-located at the opening of the new observatory.

The five daily eye observations, at 7 and 10 A. M., 1, 4 and 9 P. M., are recorded upon the usual schedule of the Central Office. Precipitation is measured at 7 A. M. 1 and 9 P. M. The means of the pressure, temperature and relative humidity are deduced from the observations at 7, 1 and 9, and for the pressure and temperature also from the hourly and two-hourly readings respectively. The original and reduced observations, with the sheets from the recording instruments, are sent from time to time to Zürich. The 7 A. M. observation and that of the preceding evening are telegraphed each morning to Zürich, and thence go to the meteorological offices in Vienna and Rome, to be included in their daily weather bulletins. The 1 P. M. observation is immediately telegraphed to Zürich and Hamburg, and with the morning observation appears the same afternoon in the Swiss *Bulletin* and in that of the *Deutsche Seewarte.*

Results of the Observations.—The detailed observations have been published annually in the *Annalen der Schweiz. meteor. Centralanstalt,* and discussed elsewhere by Billwiller, Maurer, and others. The results for the five years ending with August, 1887, are discussed by Billwiller in a pamphlet recently issued by the Naturalists' Society of Zürich.

The highest temperature during the period was 20.7° C., and the lowest —22.8°, the mean annual temperature of —1.9° C. corresponding to that of Lapland. The climate of the Sentis is less remarkable from its extreme winter cold than from its relatively low summer temperature. The station Bevers, 760 m. lower, is colder in winter, but much warmer in summer. The annual range of the monthly means is much smaller on the Sentis than at the valley stations. The daily range is also less,

especially in summer. The decrease of the annual and daily temperature variation with height, clearly shown by the Sentis observations, is confirmed by those made on the Sonnblick. Thus it is that the differences of temperature between a free-lying mountain and a valley in summer and at noon are greater than during the winter and at night. The mean decrease of temperature per 100 m. in the stratum of air between St. Gallen and the Sentis (1787 m.) varies from 0.37° C. in January to 0.66° in June, the annual mean being 0.52°, while between the Rigi and the Sentis (670 m.) the decrease varies from 0.51° in March and April to 0.67° in July, and the annual mean is 0.58°. Sometimes, during periods of high pressure, there is an actual inversion of the temperature. Thus, during five days of January, 1887, the mean temperature on the Sentis was 3.7° C. higher than at St. Gallen.

The observations of pressure show a minimum in March and April as at the neighboring low-level stations, but the July maximum is much more pronounced, being 9.3 mm. greater than the January mean, instead of 1.2 mm. at Zürich. The double diurnal period is universal, but the amplitude and times, as compared with those at low levels, are greatly modified. Thus, at Berne, the range during the day is much larger than during the night, especially in summer, while on the Sentis the reverse is the case. The day maximum, which occurs in summer at the lower station at 8 A. M., on the Sentis is retarded until 2 P. M., while the afternoon minimum becomes much less marked, and the early morning minimum more so.

The mean annual relative humidity differs but one per cent. from that at St. Gallen, but the annual and diurnal periods are very different. The driest months on the Sentis are January and February, at St. Gallen they are April and May. The diurnal period at the latter station, which is related to that of the temperature, having its greatest amplitude in summer, almost disappears at the high station. During anti-cyclonic weather, when there is a descending current, the relative humidity on the Sentis has fallen as low as 15 per cent. The mean annual cloudiness, in like manner, differs but little from that at

the lower stations, but is differently distributed. On the Sentis, January and February are the clearest months, while the minimum cloudiness below is in summer.

The annual precipitation is nearly the same as at St. Gallen. The precipitation there, however, is large for a valley station, while on the Sentis much of the snow is blown out of the gauge. The monthly totals show the maximum at both stations to occur in summer and the minimum in winter. The prevailing winds are westerly and southwesterly and, together with the observations at other mountain stations in the temperate zones, demonstrate the general atmospheric circulation of the upper air.

COMPARISON OF STANDARD BAROMETERS.

By Frank Waldo.

PART I.

The Signal Service having purchased of Fuess, in Berlin, several of the combined cistern-syphon barometers, known as the Wild-Fuess Control barometers, a comparison of these barometers was made with some of the best known standards of Europe. These Signal Service portable barometers used in these comparisons bear the following makers' numbers: (Fuess), 152, 141, 150, 132. The compilation of the report of the comparisons was intrusted to me, and I prepared a paper, of about 250 pages of manuscript, giving a narrative of the comparisons and a description of the various normal barometers compared and the comparison barometers. In describing the various instruments I have given the original descriptions (translated into English) where they were accessible, thus bringing into one paper the literature of the subject, and fully illustrated. This paper is mentioned in the Chief Signal Officer's Report for 1886, see Prof. Abbe's report of the Study Division, page 210, as being accepted for publication but not yet printed.

An abstract of the results of these comparisons, with some subsequent comparisons made in America, has been given in the Monthly Weather Review for April, 1887, and at the request of the editor of this journal I have prepared the following tables, based on the data given in the Weather Review.

EUROPEAN COMPARISONS. TABLE I.

Place.	Date of Comparisons.	Bar. Fuess 152.	mm.	Bar. Fuess 141.	mm.	Bar. Fuess 150.	mm.	Bar. Fuess 132.	mm.	Observers.
St. Petersburg—Cent. Phys. Obs.	August, September and December, 1882.	C. O. N. — F. 152	= —.11	Cent. Obs. Nor. — F. 141	= —.30	C. O. N. — F. 150	= —.20			A. Bellikow. Ed. Stelling. Rykatschew. Stresnewsky. H. Wild.
Berlin—Prus. Met. Bure'u (Bure. Statis.)	The Spring of 1883. (Mar. ?)					C. O. N. — F. 150	= —.20			G. Hellmann.
						F. 76 — F. 150	= —.14			
						C. O. N. — F. 76	= —.06			
Berlin—Norm'l Aichungs Kommission.	The Spring of 1883. (Mar. ?)	C. O. N. — F. 152	= —.11	C. O. N. — F. 141	= —.30	C. O. N. — F. 150	= —.20			M. Thiesen.* H. F. Wiebe.*
		F (F. 38) — F. 152	= —.08	F. (Fuess 38) — F. 141	= —.28	F. (Fuess 38) — F. 150	= —.14			
		C. O. N. — F. (F. 38)	= —.03	C. O N. — F. (Fuess 38)	= —.02	C. O. N. — F. (Fuess 38)	= —.06			
		B. (F. Nor.) — F. (F. 38)	= +.20	B. (F Nor.) — F. (Fuess 38)	= +.20	B. (F. Nor.) — F. (F. 38)	= +.20			
		C. O. N. — B. (F. Nor.)	= —.23	C. O. N. — B. F. (Nor.)	= —.22	C. O. N. — B. (F. Nor.)	= —.26			
Vie: na—Cent. Anstalt.	April 27, 28, 30, and May 2, 3, 4, 5, 6, 1883	C. O N. — F 152	= —.11	C. O. N. — F. 141	= —.30	C. O. N. — F. 150	= —.20			St. Kostlivy. J. M. Pernter. F. Waldo.
		Pistor 279 — F. 152	= —.01	Pistor 279 — F. 141	= —.24	Pistor 279 — F. 150	= —.15			
		C. O. N. — Pistor 279	= —.10	C. O. N. — Pistor 279	= —.06	C. O N. — Pistor 279	= —.05			
St. Petersburg—Cent. Phys. Obs.	June 12, 13, 14, 15, 1883.							C. O. N. — Browning 44	= —.01	Ed. Stelling.
								Browning 44 — F. 132	= —.08	F. Waldo.
								C. O. N. — F. 132	= —.09	
Ha burg—Deutsche See-warte.	June 30 and July 2, 3, 1883.	C. O. N. — F. 152	= —.11	C. O. N. — F. 141	= —.30	C. O. N. — F. 150	= —.20	C. O. N. — F. 132	= —.09	A. Sprung. F. Waldo.
		F. 9 — F. 152	= +.35	F. 9 — F. 141	= +.19	F. 9 — F. 150	= +.29	F. 9 — F 132	= +.45	
		C O. N. — F. 9	= —.46	C. O. N. — F. 9	= —.49	C. O. N. — F. 9	= —.49	C. O. N. — F. 9	= —.54	
Kew—Observatory.	July 28, 29, 30, 1883.	Newman 34 — F. 152	= +.13	Newman 34 — F. 141	= —.08					Mr. Foster. F. Waldo.
		Kew Nor. — Newman 34	= —.08	Kew Nor. — Newman 34	= —.08					
		Kew Nor. — F. 152	= +.05	Kew Nor. — F. 141	= —.16					
		C O. N. — F. 152	= —.00	C. O. N. — F. 141	= —.25					
		C. O. N. — Kew Nor.	= —.05	C. O. N — Kew Nor.	= —.09					

Hamburg—Deutsche Seewarte.	August 9, 10, 13, 15, 16, 17, 21, 23, 1883.	C. O. N. — F. 152 = —.00 F. 9 — F. 152 = + .47	C. O. N. — F. 141 = —.25 F. 9 — F. 141 = + .24	C. O. N. — F. 150 = —.20 F. 9 — F. 150 = + .34	C. O. N. — F. 132 = —.09 F. 9 — F. 132 = + .43	F. Waldo.
		C. O. N. — F. 9 = —.47	C. O. N. — F. 9 = —.49	C. O. N. — F. 9 = —.54	C. O. N. — F. 9 = —.52	
Sevres, Paris—Int. Bureau Wts. and Measures.	August 30, 31, and September 1, '83.	C. O. N. — F. 152 = —.00 F. 137 — F. 152 = + .20	C. O. N. — F. 141 = —.25 F. 137 — F. 141 = —.08			M. Thiesen. F. Waldo.
		C. O N. — F. 137 = —.20 Cor. of F. 137 referred to	C. O N. — F. 137 = —.17 Nor. I, Nor. II not known.			
		C. O. N. — F. 152 = —.00 W'' Turrettini — F. 152 = + .08	C. O. N. — F. 141 = —.25 W'' (Turrettini) — F. 141 = —.19			
		C. O. N — W'' = —.08 Sevres Nor. I — W'' = + .13	C. O. N. — W'' = —.06 Sevres Nor. I — W'' = + .13			M. Thiesen. F. Waldo.
		C. O. N. — Sevres Nor. I = —.21 Also by F. 152.	C. O. N. — Sevres Nor. I = —.19 Also by F. 141.			
		C. O. N. — W'' = —.08 Sevres Nor. II — W'' = + .10	C. O. N. — W'' = —.06 Sevres Nor. II — W'' = + .10			
		C. O. N. — Sevres Nor. II = —.18	C O. N. — Sevres Nor. II = —.16			
Paris—Central Meteor. Bureau.	September 1, 2, '83.	Alvergniat — F. 152 = + .05 Regnaults Nor —Alvergniat = —.04	Alvergniat — F. 141 = —.19 Regnaults Nor.—Alvergniat = —.04			F. Waldo.
		Regn. Nor — F 152 = + .01 C. O. N. — F 152 = —.00	Regnaults Nor. — F. 141 = —.23 C. O. N. — F. 141 = —.25			
		C. O. N. — Regnaults Nor. = —.01	C. O. N. — Regnaults Nor. = —.02			
Paris†—Astron. Observ.	September 3, 1883.	C. O. N. — F. 152 = —.00 Fortin — F. 152 = —.14	C. O. N. — F. 141 = —.25 Fortin — F. 141 = —.39			F. Waldo.
		C. O. N. — Fortin = + .14	C O. N. — Fortin = + .14			
Hamburg‡—Deutsche Seewarte.	September 7, 10, 11, 1883.	C O. N. — F. 152 = —.00 F 9 — F. 152 = + .43	C O. N. — F. 141 = —.25 F. 9 — F. 141 = + .22	C. O. N. — F. 150 = —.20 F. 9 — F. 150 = + .32	C. O. N. — F. 132 = —.09 F. 9 — F. 132 = + .44	A. Sprung. F. Waldo.
		C. O. N. — F. 9 = —.43	C. O. N. — F. 9 = —.47	C. O. N — F 9 = —.52	C. O. N. — F. 9 = —.53	

* NOTE.—The barometers compared by M. Thiesen, H. F. Wiebe and F. Waldo in April, 1883, were not furnished the Signal Service, as was expected

† NOTE.—In this case correction Att. therm. Fortin = +0.3°C. is used, so found from these comparisons. The given official correction is —0.2°C.

‡ NOTE —In March 1886, Professor Neumayer found New Seewarte Nor. Fuess — F. 9 = —.454 mm.
∴ C. O. N. — Seewarte Nor. Fuess = — .04 mm.

AMERICAN COMPARISONS. TABLE I.

Place.	Date.	Bar. Fuess 152.	Bar. Fuess 141.	Bar. Fuess 150.	Bar. Fuess 132.	Observers.
		mm.	mm.		mm.	
Washington—Office of Chief Signal Officer.	October 15, 16, 17, 20, 22, 23, 24, 25, 1883.	C. O. N. — F. 152 = —.00 F. 152 — Green St'd = —.24	C. O. N. — F. 141 = —.25 F. 141 — Green St'd = +.01		C. O. N. — F. 132 = —.09 F. 132 — Green St'd = —.30	T. Russell. F. Waldo.
		C. O. N. — Green St'd = —.24 Mean C. O.	C. O. N — Green St'd = —.24 N. — Green St'd = —.29		C. O. N. — Green St'd = —.39	
		C. O. N. — F. 152 = —.00 F. 152 — Adie 1526 = —.06	C. O. N. — F. 141 = —.25 F. 141 — Adie 1526 = +.18			T. Russell. F. Waldo.
		C. O. N. — Adie 1526 = —.06 Mean C. O N.	C. O. N. — Adie 1526 = —.07 — Adie 1526 = —.06.			
		C. O. N. — F. 152 = —.00 F. 152 — Adie 1555 = —.27			C. O. N. — F. 132 = —.09 F. 132 — Adie 1555 = —.29	T. Russell. F. Waldo.
		C. O. N. Adie 1555 = —.27 Mean C. O. N.	— 1555 = — .32.		C. O. N. — Adie 1555 = —.38	
New Haven—Yale Observ.	October 27, 1883.	F. 152 — Green 2725 = —.11 C. O. N — F. 152 = —.00				F. Waldo.
		C. O. N. — Green 2725† = —.11				
		F. 152 — Yale Obs. = +.03 C. O. N. — F. 152 = —.00				F. Waldo.
		C. O. N. — Yale Obs. = +.03				
Cambridge—Harvard Observ.	October 31, and November 1, 1883.	F. 152 — Newman 68 = +.24 C. O N. — F. 152 = —.00				A. Searle. F. Waldo.
		C. O. N. — Newman 68 = +.24				
Boston—Sig. Ser Station.	November 2 and 3, 1883.	F. 152 — Green {2489, 465} = +.40 C. O. N — F. 152 = —.00				O. B. Cole. F. Waldo.
		C.O.N — Green {2489, 465} = +.40				
		F. 152 — Green 1707 = +.00 C. O. N. — F. 152 = —.00				O. B. Cole. F. Waldo.
		C. O. N. — Green 1707 = +.00				

Toronto—‡ Canada Meteor. Observ.	November 8 and 9, 1883.	F. 152 — Newman 33 = +.04 C. O. N. — F. 152 = —.00				C. Carpmael. F. Waldo.
		C. O. N. — Newman 33 = +.04				
New York—Maritime Exchange.	Nov. 13 and 14, 1883.	F. 152 — Adie 1600 = —.24 C. O. N. — F. 152 = —.00				F. Waldo.
		C. O. N. — Adie 1600 = —.24				
Philadelphia—Maritime Exchange.		F. 152 — Adie 1712 = +.00 C. O. N. — F. 152 = —.00				T. F. Townsend. F. Waldo.
		C. O. N. — Adie 1712 = —.00				
		C. O. N. — F. 152 = —.00 F. 152 — Green St'd = —.38	mm. C. O. N. — F. 141 = —.25 F. 141 — Green St'd = —.10	mm. C. O. N. — F. 150 = —.20 F. 150 — Green St'd = —.19	mm. C. O. N. — F. 132 = —.09 F. 132 — Green St'd = —.27	T. Russell. W. Hammon.
		C. O. N. — Green St'd = —.38 Mean C. O. N. — Green St'd = —.37	C. O. N. — Green St'd = —.35	C. O. N. — Green St'd = —.39	C. O. N. — Green St'd = —.36	
Washington—Signal Office.	June 7, 9, 10, and 11, 1884.	C. O. N. — F. 152 = .00 F. 152 — Adie 1526 = —.25	C. O. N. — F. 141 = —.25 F. 141 — Adie 1526 = +.03	C. O. N. — F. 150 = —.20 F. 150 — Adie 1526 = —.03	C. O. N. — F. 132 = —.09 F. 132 — Adie 1526 = —.16	T. Russell. W. Hammon.
		C. O. N. — Adie 1526 = —.25 Mean C. O. N. — Adie 1526 = —.24	C. O. N. — Adie 1526 = —.22	C. O. N. — Adie 1526 = —.23	C. O. N. — Adie 1526 = —.25	
		C. O. N. — F. 152 = .00 F. 152 — Adie 1555 = —.33	C. O. N. — F. 141 = —.25 F. 141 — Adie 1555 = —.06	C. O. N. — F. 150 = —.20 F. 150 — Adie 1555 = —.19	C. O. N. — F. 132 = —.09 F. 132 — Adie 1555 = —.26	T. Russell. W. Hammon.
		C. O. N. — Adie 1555 = —.33 Mean C. O. N. — Adie 1555 = —.34	C. O. N. — Adie 1555 = —.31	C. O. N. — Adie 1555 = —.39	C. O. N. — Adie 1555 = —.35	

*NOTE.—A correction of .10 mm. is still to be applied to the Green St'd. This is supposed to give the Kew St'd as represented by Adie 1526 and Adie 1555 at the time they were received here with the Kew certificates.

†NOTE.—Green 2725 is the standard for the Panama Canal Survey.

‡NOTE.—Actual reading of Newman 33. A correction of .18 mm. still to be added to get the adopted observatory standard.

In Table I the record of each barometer has been kept separate from the others; the only time when they were combined was at Hamburg, after the journey to Kew, in order to find how much the lower indices (zero points for the scales) of Fuess 141 and Fuess 152 had been accidentally moved while at Kew and just *before* the comparisons at Kew. The amount of this change was determined by the intercomparison of barometers at Hamburg just before the journey to Kew and after the journey to Kew. For more ready reference the comparisons made with each of the Signal Service barometers are put in separate vertical columns in this table.

The numbers attached to the maker's name are the numbers of the instruments.

C. O. N. refers to the St. Petersburg Central Observatory Normal barometer, which is here used as the standard to which other instruments are referred.

F refers to Fuess as maker of the instrument, except in one case at Berlin (N. A. K.) where it is also used to designate a certain working standard.

"The barometer Adie 1526, with a correction of +.05 mm. (0.002), was adopted by Gen. Greely as the standard of the Signal Service in March, 1887."

The barometer Adie 1555 was also used with a correction of +.05 mm..

The barometer Green Standard has a correction of —.10 mm.

These corrections applied to the Washington Observations, given in Table I, are the results adopted at the Signal Service, and differ but slightly from those found in Table II.

PART II.

As, however, 4 barometers were compared at St. Petersburg, and also several times at Hamburg, and only 2 barometers were compared at Kew and Paris, it has been thought that the results of all four barometers as obtained by the frequent comparisons at Hamburg ought to enter into the entire series of comparisons.

The three comparisons of 4 barometers at Hamburg show the Seewarte Standard F. 9 to be about .50 mm. higher than the Cent. Phys. Obs. Normal at St. Petersburg. Assume, then, St. Petersburg, C. O. N. — Hamburg Fuess 9 = —.50 mm., and from this redetermine the corrections of the Signal Service barometers F. 141, F. 150, F. 152, and F. 132.

We find for a result the following corrections:

		At Hamburg Before Journey to Kew.	At Hamburg. After Journey to Kew.
		mm.	
C. O. N. — F. 141	=	—0.31	
"	=		—0.26
"	=		—0.28
"	=		—0.27 mean of after Kew.
C. O. N. — F. 150	=	—0.21	
"	=		—0.16
"	=		—0.18
"	=		—0.18 { mean of before and after Kew.
C. O. N. — F. 152	=	—0.15	
"	=		—0.03
"	=		—0.07
"	=		—0.05 mean of after Kew.
C. O. N. — F. 132	=	—0.05	
"	=		—0.07
"	=		—0.06
"	=		—0.06 { mean of before and after Kew.

If now these mean corrections, which would seem to give the most probable results, are used in the reduction of the comparisons at the various observatories, we obtain the results given in Table II, which the writer thinks should be adopted as the final results of the comparisons.

The corrections used are then:

	mm.
For Fuess 152	{ —.15 before July 27, 1883. —.05 after July 27, 1883.
For Fuess 141	{ —.31 before July 27, 1883. —.27 after July 27, 1883.
For Fuess 150	—.18 during whole series
For Fuess 132	—.06 during whole series.

Table II. European Comparison.

Corrections referred to St. Petersburg Nor. Barometer by Brauer. C. O. N.

Place.	Date.	Barometer Compared.	By F. 132.	By F. 141.	By F. 150.	By F. 132.	Mean Correction.
			mm.	mm.	mm.	mm.	mm.
Berlin— Prus. Met. Bur.	Spring, 1883.	Fuess 76.			—.04		—.04
Berlin— Nor. Aich. Kom.	Spring, 1883.	Fuess 38 (F).	—.07	—.03	—.04		—.05
		Fuess Nor. (B.).	—.27	—.23	—.24		—.25
Vienna— Central Austalt.	April 27, 28, 30, and May 2, 3, 4, 5, '83.	Pistor 279.	—.14	—.07	—.03		—.08
Hamburg— Seewarte.	June 30, and July 2 and 3, 1883.	Fuess 9.	—.50	—.50	—.47	—.51	—.50
		New F. Normal.					—.046
Kew—	July 28, 29, 30, 1883.	Kew Nor.	—.10	—.11			—.10
Hamburg— Seewarte.	August 9, 10, 13, 15, 16, 17, 21, 23, 1883.	Fuess 9.	—.52	—.51	—.52	—.49	—.51
Serves— Int. Bur.	August 30, 31, and September 1, '83.	Nor. I.	—.26	—.21			—.24
		Nor. II.	—.23	—.18			—.20
Paris— Cent. Met. Bur.	September 1, 2, '83.	Alvergniat	—.10	.08			—.09
		Regnaults Nor.	—.06	—.04			—.05
Paris— Astronom. Obs.	September 3, 1883.	Fortin.	+.09	+.12			+.10
Hamburg— Seewarte.	September 7, 10, 11, 1883.	Fuess 9.	—.48	—.49	—.50	—.50	—.49

Table II, American Comparisons.

Place.	Date.	Barometers Compared.	By F. 152.	By F. 141.	By F. 150.	By F. 132.	Mean Correction.
			mm.	mm.	mm.	mm.	mm.
Washington— Signal Office.	October 15, 16, 17, 20, 22, 23, 24, 25, '83.	Sig. Ser. Green St'd of 1879.	—.29	—.26		—.36	-.30
			correct'n of —.10 appl'd				-.20
		Adie 1526.	—.11	—.09			-.10
			correct'n of +.05 appl'd				-.15
		Adie 1555.	—.32			—.35	-.34
			correct'n of +.05 appl'd				-.39
New Haven— Yale Col. Obs.	October 31 and November 1, 1883.	Green 2725. Pan. Canal St'd.	—.16				
		Green Yale Obser. bar.	—.02				
Cambridge— Harvard Obser.	October 31 and November 1, 1883.	Newman 68.	+.19				
Boston— Sig. Ser. Station.	November 2 and 3, 1883.	Green (2489) 465,	+.35				
		Green 1707.	—.05				
Toronto— Can. Met. Obs.	November 8 and 9, 1883.	Newman 33.	—.01				
		Newman 33 + 0.18.	—.19				
New York— Maritime Exch.	November 13 and 14, 1883.	Adie 1600.	—.29				
Philadelphia— Maritime Exch.	November 21, 1883	Adie 1712.	—.05				
Washington— Signal Office.	June 7, 9, 10, 11, 1884.	Green Standard.	—.43	—.37	—.37	—.33	—.38
			correct'n of —.10 appl'd				—.28
		Adie 1526.	—.30	—.24	—.21	—.22	—.24
			correct'n of +.05 appl'd				—.29
		Adie 1555.	—.38	—.33	—.37	—.32	—.35
			correct'n of +.05 appl'd				—.40

From Table I it is easy to note the stability of the comparison instruments by taking the differences at the various places of comparison.

In the following table is given the difference between Fuess 152 and the other barometers as obtained in many cases through the observatory barometer compared.

	F. 152 — F. 141.	F. 152 — F. 150.	F. 152 — F. 132.
	mm.	mm.	mm.
St. Petersburg, Sept.—Dec., 1882.	—.19	—.09	+.02 (June, 1883)
Berlin, March, 1883.	—.20	—.06	....
Vienna, April—May, 1883.	—.23	—.10	....
*Hamburg, June—July, 1883.	—.16	—.06	+.10
*Kew, July, 1883.	—.21	....	....
Hamburg, August, 1883.	—.23	—.13	—.04
Sevres, Aug.—Sept., 1883.	—.28 —.27	....	....
Paris, Met. Bur., Sept., 1883.	—.24	....	....
Paris, Ast Obs., Sept., 1883.	—.25	....	....
Hamburg, Sept., 1883.	—.21	—.11	—.01
Washington, Oct., 1883.	—.25 —.24	....	+.06 .... +.02
Washington, Dec., 1883.	—.23	....	—.02
Washington, May, 1884.	—.23	—.16	+.03
Washington, June, 1884.	—.28 —.28 —.27	—.19 —.22 —.14	—.11 —.09 —.07

In closing, I would add that it is my belief that, up to the time when I ceased my connection with this work,—the middle of May, 1884—the zeros of reference of the scales of the travelling barometers suffered no changes except at Kew, and this has been taken into account.

CINCINNATI, OHIO, February, 1888.

*NOTE.—Barometers F. 152 and F. 141 were changed between these two comparisons.

CORRESPONDENCE.

To the Editors:—At 2:30 p. m., July 2nd, I saw a meteor pass across the northern "sky" at an elevation of about 30°. It appeared as large as my head and left a considerable "tail" behind it.

Thinking it might interest you, I have ventured to address you.

Respectfully,

W. F. Edwards.

Niles, Mich., July 5, 1888.

DEATH FROM COLD IN BLIZZARDS.

To the Editors:—The writer of a very appreciative review of my book, "Weather," in the American Meteorological Journal for March, 1888, seems to think that when I stated that persons frozen to death in *blizzards* on the prairies, frequently strip themselves nearly naked. I have been the victim of a humorist.

Such, however, is not the case. In Chapter XIII of Mr. H. M. Robinson's, "The Great Fur Land," G. Putnam's Sons, New York, 1879, will be found a graphic description of the subjective sensation of warm, felt by a freezing man; and on p. 314 appears the following note:

"I have had five cases of freezing to death brought under my personal observation. In every case the subject gave indubitable indications of insanity before death, and in every case exhibited it in the same way—by casting off his clothing and wandering away from it. One subject was entirely nude, and distant fully a mile from the last article of clothing he had discarded."

I have also a dim recollection of hearing something of the sort, when I lived in Canada many years ago.

Yours faithfully,

Ralph Abercromby.

21 Chapel St., London, S. W., June 6, 1888.

CURRENT NOTES.

Marine Isotherms.—The migrations and spawning grounds of fish depend largely on the temperature of the water, to changes of which these animals are naturally very sensitive. The U. S. fish commission, therefore, pays great attention to temperature, and to the "Grampus" this summer has been assigned, among other things, the duty of studying the isothermals of bays and off the coast, and their migrations with the season. Her field is from the capes of Virginia northward; she will make observations of temperature at the surface and on the bottom. Many such observations are now on hand, and it is expected that this summer's work will so far complete them that they can be plotted and published.

Southern California*.—This book of Drs. Lindley and Widney is one of a numerous class but it differs from its fellows in containing much information interesting to meteorologists and sanitarians. It also impresses the reader as trust-worthy and authentic, in which respect it differs widely from many similar American hand-books. The pretty climatological map facing the title is copied from that published by the Southern Pacific Railway Company. A special division of the book is devoted to the comparative climate of Southern California and the Atlantic coast of the United States, and meteorological tables are scattered through the remainder. Especial and discriminating accounts are given of the various health-resorts. Great praise is given to the climatal attractions of this part of the Pacific coast, but its climate probably fully deserves the the praise they give it.

Michigan State Board of Health.—The fourteenth annual report (for 1886), is an octavo volume of 391 pages, similar to its predecessors. The first part, of 80 pages, is devoted to the

*California of the South, its Physical Geography, Climate, Resources, Routes of Travel, and Health-Resorts, being a complete guide-book to Southern California. By Walter Lindley, M. D., and J. P. Widney, A. M., M. D. Octavo, 377 pp. with maps and numerous illustrations. New York, 1888.

meteorological work of the board with graphical illustrations of the progress of the meteorological elements. The number of stations reporting is 23 and they are well distributed over the State. As an introduction to this part of the report is given a statement of the sanitary bearings and value of meteorological statistics, which occupies only a few pages and is very tersely put. In the remainder of the report, also, there is much that will interest meteorologists. Dr. Baker, the veteran and industrious secretary of the board, is an especial student of the relations of disease to meteorology; his conclusions are the result of patient and careful study and are well worthy of respectful attention. One of his studies is noticed elsewhere in this number of the JOURNAL.

THE SIGNAL SERVICE BIBLIOGRAPHY.—Mr. C. J. Sawyer, the bibliographer of the Signal Office, has received on examination an appointment as examiner in the Patent Office. His resignation from the Signal Office is to be regretted, as it may postpone the final publication of the bibliography of meteorology which has been under preparation there for some time. Mr. Sawyer is especially fitted by nature and training for such work, and it has been carried on by him with great talent, skill, and judgment. Such a work is greatly needed for English readers, as Hellmann's bibliography is in German and relates largely to German writers.

We have learned since the above was written that Mr. O. L. Fassig, formerly an assistant in this work, has received the appointment through the Civil Service. We are informed that he is a worthy successor to Mr. Sawyer, and the bibliography will not suffer from the change.

CAUSATION AND PREVENTION OF PNEUMONIA.—A pamphlet on the "Causation of Pneumonia," by Dr. Henry B. Baker, is being distributed by the Michigan State Board of Health. It is an 85-page pamphlet, and is a compilation of statistics collected by the State Board of Health, relating to pneumonia in Michigan and in other parts of the world. It is a thorough consideration

of the subject, and seems to prove that pneumonia is controlled by temperature and humidity of the air. The pneumonia increases after the atmosphere is cold and dry, and decreases after the air is warm and moist. One would suppose that such climatic causes could not be controlled, but Dr. Baker points out how he thinks the disease may be greatly lessened by controlling the temperature, and especially by moistening all air which requires to be warmed, in all buildings, public and private. During the time of greatest danger from this disease (cold weather) most people spend half their time in buildings where such conditions can be controlled, and Dr. Baker claims that it is the long-continued exposure that causes this disease; so that, if the indoor conditions are properly cared for, this disease will be greatly lessened.

THE BATAVIA (*Java*) OBSERVATORY.—This valuable institution has of late years had a history which well illustrates some of the difficulties of scientific work in the tropics. In May, 1882, the eminent first director, Dr. Bergsma, died after the publication of five excellent volumes of observations. He was succeeded by the sub-director, Dr. Van der Stok. The computer then fell ill and was obliged to return to Europe, leaving Dr. Van der Stok alone, and in 1882 he was taken ill and had to retreat to one of the sanitary hill-stations of the island, and finally to Europe, and Lieut. Poortman was detailed from the navy to continue the work. Later Dr. Figee was appointed director, and Mr. Goos computer, and by 1886 the force at the observatory was once more complete and on the ground. The Javanese assistants can be trusted only with the simpler work, and there are many things which render the observations more difficult than in Europe or North America. For instance, the photo graphic record sheets will not keep, but must be made fresh each day.

The publications issued by the observatory are now annual and consist of a thick folio volume of magnetic and meteorological observations, and an octavo volume of rainfall. The instrumental outfit is quite complete, and the publications are those of

an observatory of the first order on the international plan. The observations are given for each hour, and include atmospheric electricity, for which an automatic electrometer of Mascart's form with water dropping collector is employed. The vapor tension observations are not given, but these data can be deduced from the relative humidity and temperature which are given for each hour.

In the octavo volumes are given the daily rainfall for all stations,--183 stations for 1886, for which the observations are complete for 152 stations. Of these 102 are on the Java and Madoera, 41 on Sumatra and adjacent islands, and 40 on other islands of the Eastern archipelago.

THE MICHIGAN STATE WEATHER SERVICE.—The first annual report of its director, Sergant N. B. Conger, enables us to state some facts concerning their service. Its expense has been $4,800, over $600 less than the amount appropriated. Of this only $711 were expended for salaries, while $2,087 were expended for instruments. Twenty-six sets of railway signals are controlled by this service, one for each earliest morning train each way on eight principal roads and branches; 142 stations are now in operation displaying weather and temperature signals in the state; 40 of these are furnished by the U. S. Signal Service, 75 by the State Weather Service, and the remaining 27 by the C. & G. T. Ry. Co., the G. R. & I. Ry Co., and the Michigan Postal Telegraph Co. Many of the stations are supplied by telephone. The per cent. of the verification at all the stations is 83.

There are 148 voluntary observers in the service. The results are published monthly by the Michigan Crop Report as provided by statute. The organization of the service has been rapidly completed and the service is now a most excellent one.

WAVES OF PRECIPITATION.—On the automatic registry sheets for precipitation, one often notes marked waves of rainfall, the rain rarely falling uniformly but in varying intensity, making alternate crest and hollow on the sheets. M. Hervé Mangon

has taken the trouble to study these for Paris for the ten years from 1860 to 1870, and the account of his results, seen by us, is to be found in the *feuilleton* of the *Journal des Débats*. The greatest wave found by him was on January 16, 1867, and lasted ten hours, from one to eleven in the evening. Two waves lasted more than 8 hours, two more than 7, three more than 6. Twice, 29 waves were noted in 24 hours,—November 10, 1868, and March 2, 1869. On the day before the latter there were 19 waves, making 48 in 48 hours. During this period there were ten days of 20 waves each, two days of 21, three days of 22, one day of 25, and two days of 27.

The longest interval without rain was 26 days - from September 11 to October 6, 1867; there was also one period of 25 days without rain, one of 20, two of 16, etc. The greatest number of consecutive rainy days was 18; there were three periods of 17, two of 13, two of 12, five of 11, and nine of 10 days. On the average there are at Paris 190 days of rain per year, but out of 100 hours only 5 are rainy on the average.

THE MINERAL WATER RESORTS OF CENTRAL FRANCE*.—Under the title given in the note the French Society of Hygiene has just published an interesting volume (octavo, 232 pp.), on the hydrological tour, organized by it last September, to enable physicians to visit the mineral water resorts of Central France. The work falls into three parts: the first comprehends the scientific part and includes general considerations on the therapeutic value of waters and climate. The second gives a narrative of the journey, and in the third are given lectures delivered at each resort by the inspecting and consulting physicians.

The book is evidently written with impartiality. It will be consulted profitably by all physicians, and read with interest by invalids and tourists. This volume is, moreover, the beginning of a series. The society intends to organize each year a similar tour so as to permit physicians to visit all the mineral water

---

*Les stations d'eaux minérales du centre de la France.—La Caravane hydrologique de 1887, par le Dr. de Pietra Santa et A. Joltrain. Société francaise d'hygiène, 30, rue du Dragon, et Georges Carré, éditeur, 58, rue Saint-André-des-Arts, Paris.

resorts of France. The excursion this year will be made to the Vosges. This amounts to the creation of a true course in hydrology at the places of interest themselves, a course hitherto lacking in medical instruction. It is an example which could be followed by physicians in this country.

THE MOON AND THE WEATHER AT BATAVIA (JAVA).—In the appendices to the volumes of observations at Batavia, Dr. van der Stok publishes studies of the influences of the moon on the meteorological elements. He finds an appreciable effect on the cloudiness. The cloudiness there increases with the increase of the distance of the moon above the horizon, reaching its maximum at the superior meridian transit and its minimum at the inferior one. Thus the influence of the moon appears to be felt when she is below the horizon, which excludes the hypothesis of its being the result of direct radiation. There is also greater cloudiness at full than at new moon. In each case the extreme difference averages about 5 per cent. The temperature, too, proves to be somewhat higher when the moon is below than when she is above the horizon, and in October and November the difference amounts to almost one degree Fahrenheit. The lunar effect is more marked in the west than in the east monsoon.

Batavia is especially suited to the study of the atmospheric tides, as irregular barometric disturbances are unknown there. The existence of such tides is more and more completely proved as the number of observations increases; but the tides are small, though not so small as the mechanical theory of tides requires.

ROUMANIAN METEOROLOGY.—The second annual volume of the Roumanian Service (for 1886) is a quarto volume, like its predecessor, of 321 pages, printed in parallel columns in Roumanian and French. The resemblance of Roumanian to Latin is superficially striking but proves illusory on closer examination. From the report we learn that the service is a part of the Meteorological Institute which is an appanage of the government department of agriculture. The Institute has now one station of the first order (Bucharest), 16 of the second, and 13

rain stations. The observatory at Bucharest has found a benefactor in Vasile Paapa who bequeathed it, in trust to the Institute, the sum of $10,000.

This volume also contains three papers by Dr. St. Hepites, the director of the service. One treats of the climate of Bucharest for 1885, in which, however, are discussed observations since (and including) 1851. The second treats of the barometric readings at Bucharest, and the third lays the plans for a perfected weather service.

The observations published are for Bucharest and include those usual in stations of the first class. Many observations from other parts of the kingdom are now available and will be published in the future. This entire great volume seems almost exclusively the work of the director, and shows an enormous amount of labor on his part. It is quite evident that Roumania will soon be added to the list of effective national weather-services.

The Kansas State Weather Service is under the direction of Professor J. T. Lovewell, of Topeka, with Sergeant T. B. Jennings, Signal Service, U. S. A., as assistant. The reports before us are for January, February, and March, and are published in the quarterly report of the Kansas State Board of Agriculture. The weather reports for the month are prepared by Professor F. H. Snow from observations taken at Lawrence. We find forty-five stations reporting in this service.

Of especial interest is the following account of a tornado reported in March by Mr. D. C. Rath, of Halstead:

"On the 1st, a tornado, at about 4:15 to 4:30 p. m., demolished the house of Wm. Mirron, of this place, on his farm about four miles south from here. It was occupied by Jacob Duercks. Mrs. Katherine Juntzen, after sending the family to the cellar, was in the act of repairing thither herself, and was about half-way down the stairs, when the house moved, crushing her to death instantly. The house was rolled over and destroyed. No one else hurt. It may be somewhat remarkable that the highest average temperature for the month was on the 1st, the day on

which the wind did so much damage south of here and at Newton, and that the temperature for the month was 42°, against 47° last year, same month."

This service was the first, and is still we believe the only, state service to issue weekly precipitation charts. Michigan issues tables of normals and departures weekly, and this is not done in Kansas, solely because, apparently, the number of years of observation do not justify it.

THE FORMULA FOR THE BAROMETRIC MEASUREMENT OF ALTITUDES.—In the current volume of the *Repertorium der Physik* (pages 161–168) Dr. J. M. Pernter treats anew of this difficult subject, which, though much discussed, has not yet been exhausted. The chief novelty of his treatment is in introducing into the formula before integration Poisson's expression for gravity which includes its modification by continental position. In addition to this Dr. Pernter employs the value of the constants as determined by Col. Clarke (the radius of the earth) and by the Bureau international des poids et mesures. In an alternative formula Dr. Hann's expression for the pressure of the vapor of water, is given. In order to use these formulas the observations must be corrected for gravity both in latitude and in altitude. The article ends with a set of tables for convenient computation of the corrections and of the differences of elevation, with a couple of examples.

LOCAL INFLUENCE IN TORNADOES.—In the Kansas Crop and Weather Bulletin for June we find the following:

"Again has Cawker City been saved from a full grown tornado by her favorable location at the junction of two streams of water, as the clouds always separate there and follow the streams. Tuesday, the 19th, was a sultry day, and about 5 P. M. the whole western sky grew dark. At 5:15 P. M. two snake-like clouds formed in the southwest out of the darkness—one inky, the other yellowish, as of dust. In a few minutes they struck the southwest part of town nearly parallel; when just over the United Brethren church they veered east suddenly. The air was

full of shingles, dust and debris, and they combined and moved off slowly up the ravine east of town. In a few minutes a crowd ran to see the result of the storm, whose path was only fifteen feet wide. The first was the United Brethren parsonage, just built, moved on the foundation, not a square room left, so twisted, while the family were in the cellar beneath; $600 insurance. Crossing the street, sweeping the fence and barn away belonging to Mr. Traugh, it skipped a block, taking the fence of W. G. Kennedy, crossed the street cornering house of Ed. Kennedy, whose cellar was full of people. Blowing in Mr. Whiting's strong front door and bulging the north wall out and toppling over the chimney, it went over his barn, taking John Lathrop's —where, it is hard to tell, as there is not enough left to build a chicken coop, and not touching Pres. Martin's on the same alley ten feet from it; crossed to John Wood's place (uninsured), sweeping away house, iron fence, trees, barn, and carrying timbers over to H. Taylor's barn, crashing through the roof. This seemed to finish the force of it, as it slackened speed and hung over the ravine for some minutes; finishing up at J. T. Jones's residence by tearing the porch, filling the house full of dust and fragments, and carrying off bodily a large apple tree."

It is a not uncommon belief in sections subject to tornadoes and similar small storms that they show a tendency to follow the same path, and that a spot once visited by a tornado is more likely to be visited again than a neighboring spot which remained untouched the first time. The idea is by no means generally accepted, and it would be well to collect all the facts which support it.

The Density of Snow.—By the density of snow is meant the ratio between the depth of the snow and that of the water resulting from melting the snow. It can be expressed in terms of the number of inches of the snow which would be required to make one inch of water. It is usually assumed in this country that it takes ten inches of snow to make one of water, but this is only an approximate average; the result of actual melting shows great variation. Mr. A. Lancaster, meteoro-

logical inspector at the observatory at Brussels, has recently published some interesting results on this question.

These results were obtained by a study of the records at the meteorological station on Great St. Bernard in the Alps. The snow is there melted for each observation and the depth of the snow and that of the water it produces are recorded. Great St. Bernard is 8,130 feet above sea-level and is liable to snow-falls at all seasons of the year. The observations employed were those from 1862 to 1881, inclusive, 20 years in all and were about 3,000 in number.

The total snow-fall in these 20 years was 431.8 feet, and the resulting depth of water was only 46.6 feet. The resulting average density of the snow is 0.11,—or it took 9.3 inches of snow to make one of water.

This is quite near the accepted ratio of one in ten, but when the statistics are examined in detail it is found that the average value varies much with the season. This is shown below:

MONTH.	MEAN DENSITY.
January	1 : 12.1 = 0.08
February	1 : 12.3 = 0.08
March	1 : 11.4 = 0.09
April	1 : 8.9 = 0.11
May	1 : 6.4 = 0.16
June	1 : 5.5 = 0.18
July	1 : 4.1 = 0.24
August	1 : 5.7 = 0.18
September	1 : 6.7 = 0.15
October	1 : 6.8 = 0.15
November	1 : 9.9 = 0.10
December	1 : 12.0 = 0.08

The greatest density, it appears, is found in the warmest months and the least in the coldest month. The density is three times as great in July as in the winter. In individual observations similar variations are found in a single month.

The relations to temperature are distinctly shown in the following table. The temperatures are in the centigrade scale:

TEMPERATURES.	MEAN DENSITY.
+ 2°	1 : 6 = 0.17
+ 1°	1 : 7 = 0.14
0°	1 : 8 = 0.12
— 1° and — 2°	1 : 9 = 0.11
— 3°	1 : 10 = 0.10
— 4°	1 : 11 = 0.09
— 5° to — 7°	1 : 12 = 0.08
— 8° to — 10°	1 : 13 = 0.08
— 11° to — 15°	1 : 14 = 0.07

It seems that the lower the temperature the less dense the snow. At low temperatures the aqueous vapor in the air is small and the snow-crystals fine and light. This, however, does not prevent a fairly deep snow-fall in cold weather.

The present defective method of getting the equivalent rain of snow-falls could easily be improved. A simple improvement would be to make the ratio between snow-fall and rain vary with the temperature.

Rainfall and Fire-Insurance.—The *Chronicle* of New York, well known among those interested as an authority in insurance and especially recognized for its statistics of fires, says that an eminent student of fire insurance problems predicts that "considerations of rainfall and humidity will cut an important figure in fire underwriting in the next twenty-five years. We think Mr. Bennett is right. The influence which climatic conditions exert on combustion is too marked to be permanently ignored. When a larger part of the area of this country shall have become more solidly built up, and the architecture of buildings, the water supplies and the fire departments shall have become more nearly alike, taking one section with another, the effect meteorological conditions have on the fire loss will be plainly seen. Underwriters talk a great deal about "sprinkled" risks nowadays, and all admit that factories and warehouses are rendered much safer, as regards danger from fire, if they are equipped with automatic sprinklers. How can it fail to be equally true that sections of country where Nature's sprinkler is active, where rainfalls are frequent and humidity is profuse, offer fewer opportunities for ignition and less chance for rapid combustion after ignition than arid regions?"

We take it that the effects of Nature's sprinkler (meaning by that actual rainfall) is not so important to the underwriter as another meteorological element,—that called the relative humidity. With drying the combustibility of wood rapidly increases and the temperature of ignition lowers. Torrified wood kept perfectly dry is much more inflammable than charcoal, will ignite at a very low temperature,—perhaps at 250° F., but exact

observations are not known to us—and, when ignited, it burns fiercely. Wood, however, rapidly absorbs moisture from a damp atmosphere, and even torrified wood becomes like other wood when exposed to dampness. Ordinarily there is enough moisture in the atmosphere to keep the wood used in buildings and furniture more or less moist, but during a long dry season this interstitial moisture largely evaporates, and leaves the wood much in the condition of that which has been roasted. The rainfall affects directly only the surfaces of structures, the humidity affects the interiors as well as exteriors. The effects of rainfall in keeping the air moist is probably much more important to the insurers than those of direct sprinkling, and we would suggest to those to whom the statistics are accessible that they compare fire loss with humidity.

A Universal Climatal Dictionary.—Dr. L. Cruls, director of the Imperial Observatory at Rio Janeiro, sends us a circular concerning an enterprise which we can heartily commend. He says: "We believe there exists no work containing complete climatal data presented in a methodical form and collected from a large number of points over the earth's surface. Such data can only be found scattered through special publications, and they are generally incomplete, sometimes inexact, and for the most part they are expressed in units of different systems, thus necessitating for their comparison, a preliminary reduction which renders their consultation troublesome.

"We have thought that a work which would include the principal meteorological elements, obtained at the greatest possible number of stations over the globe, such as those which actually constitute the meteorological networks for the prediction of the weather, these elements being classified under a methodical form and expressed in units of a single system, would render real service to science.

"In order to obtain such a collection, the Imperial Observatory has constructed a blank form (which will be sent to all applicants) in which are designated those elements which are most interesting to know and which best characterize the climate

of a place. This form is sent to the meteorological observatories and institutions of all countries, with the request that they will fill and return them.

"We think it will thus be possible to unite documents entirely worthy of confidence concerning a considerable number of stations distributed all over the globe. Once in possession of these elements, we will give them the most appropriate classification, and thus make the proposed dictionary, which will be printed at the expense of the observatory of Brazil."

The printing will be begun as soon as the material is in, and two copies of the published results will be furnished to contributors.

CLIMATIC CHANGES IN THE WEST.—In the report of the Kansas State Board of Agriculture for the quarter ending March 31, 1888, on pages 141 to 146, Mr. H. R. Hilton, of Strong City, discusses the influence of climate and climatic changes upon the cattle industry of the Plains. Along with some meteorological views which are hardly acceptable, he insists on the favorable change in climate, which is going on unmistakably under the eyes of the settlers, and he gives his adhesion to the affect of cultivation in arresting and holding the water precipitated from the clouds. Formerly, when the Plains were burned over ever year and were, moreover, trodden down and made as hard as a floor by the great herds of buffaloes and other grazing animals, the rain, generally in heavy thunder-storms, flowed off at once. Now furrows made by the plow, the greater sponginess and ready permeability of the cultivated soil, and the planting of trees and crops, all tend to retain this water and give it off gradually by evaporation.

The above view has been frequently discussed and is already familiar, and we delay on it here no longer than to point out that the quite general agreement of settlers on the Plains to the improvement of the climate is valuable evidence, not so convincing as exact observations, yet usually under-estimated. We go on to refer to a point brought out by Mr. Hilton, which is more novel and worthy of a much more complete discussion

than it has yet received, and that is the change in the grasses on the Plains. Mr. Hilton says they are changing from buffalo and bunch grass to blue-stem and tame grasses, and, in crops, from the sorghum and millet of the early settlers to wheat, rye, barley, oats, and corn. This change has been accompanied by a change in the animal life until the buffalo, antelope, and coyote are replaced by Texas and range, and finally by high grade and pure breed cattle. The cause of these changes is of course to be sought in the gradual settlement of the country; but the argument as to climate is that these changes in vegetable and animal life could not have taken place if the climate had not become more moist. An arid climate could not develop and maintain these cultivated forms of grasses and cattle.

TORNADO INSURANCE. — Concerning tornado insurance the *Western Insurance Record* says:

"Insurance against damage by wind or tornado is a perfectly legitimate business. Can it be extensively sold, and is there profit in it? Our answer is emphatically in the affirmative.

"As to magnitude of business, tornado insurance will be just about what the companies and agents choose to make it. Aside from occasional technicalities concerning authority, there is no good reason why every fire insurance company, at least, might not consistently write tornado insurance, if so disposed. There is business and money in it, and why there should not be a general disposition for it, does not occur to us.

"In this region, we believe, the prevailing rates on this class of business are one-half cent for one year, one cent for three years, and a cent and one-half for five years. It strikes us that there ought to be a greater difference between tornado rates and fire rates, in favor of the wind business. There are substantial reasons for this opinion.

"Moral hazards and criminal hazards can never be present in tornado insurance. The insured cannot cook up a tornado and turn it loose against his house to secure the indemnity money. His enemy cannot touch off a tornado under his door. The wanton, hoodlum tramp cannot send a cyclone whirling through

a community just to see the excitement occasioned by his wantonness. These serious hazards are absent from this class of business.

"The tornado's path of destruction has never been known to be more than eighty rods wide, and often it is not over a few yards. Its path is also a short and broken one. The tornado richochets and has not been known to cling to the earth with damage for a continuous stretch of more than two hundred miles. Often it does not do so for more than five miles.

"The true tornado invariably moves from the southwest to the northeast. This is an important point to note.

"Now, then, let every company writing this business stake out its risks in lines running from the southeast to the northwest, and scatter them. Let each company work across the wind-lines, and not with the wind-lines. How can it then be badly caught? It can take no such precautions in the fire business."

To these views the *Insurance Monitor* adds the following comment:

"These are the views of a journal that is located in the tornado region, and, in general, they correspond with views we have repeatedly expressed in these columns. Especially is it important that the companies engaged should distribute their risks at right angles to the principal axis of the storm. But there is danger in making the rates too low at the start. About all new experiments in the insurance field must be conducted on rates that there is every reason to believe will be adequate. When experience shows that they can be safely lowered, competition can be relied on to secure it. The danger to the business lies in the possibility of a sweeping loss. Tornado losses are not well distributed; adequate rates and wide distribution of risks must be relied on to meet this difficulty."

OREGON.—With May of this year the Oregon immigration board and Portland board of trade began the issue of an "Oregon State Weather Review and Agricultural Report." It is a small double sheet intended for gratuitous circulation. There is an evident intention to make it include more than a

simple report of the weather service. The May number includes a brief account of the climate of Oregon, as seen by its best friends, and this we give below.

The weather service of the state is under the direction of Mr. B. S. Pague of the Signal Service. Eighteen stations reported for April. The weather service should prove very useful to this enterprising and growing state. Oregon has nothing to hide in her climate, and the better it is known the more attractive the state will appear.

The account of the climate referred to above is as follows:

"Situated as we are in the latitude of Northern New England, and enjoying, even at this time of the year (May), strawberries, vegetables of all kinds, roses and other flowers, to the inhabitants of the cold northern region of the United States these facts are truly remarkable, but the causes producing them are easily explained.

"The great Japan gulf current, flowing by our shores on the west, and the chain of mountain ranges on the north and east, modify our climate to such an extent that if it were not for these conditions we should experience that severity of weather so common in the northern part of the Eastern States. As it is, our climate is mild and healthful, and a temperature of 100 degrees during the hottest period in summer is unusual, and zero in winter is more so. The immediate coast region has a smaller range of temperature, while the great 'Inland Empire' of Eastern Oregon has more frequently a temperature of 100 degrees in summer, and zero in winter, than have the large and fertile valleys of the interior.

"The appellation of 'web-feet' is conferred on Oregonians, but this is a misnomer. True, we have our rainy and dry seasons, but by the one we do not mean continuous rain, nor by the other a continuance of dry weather. By the former it should be understood that it is merely to designate the possibility of rain rather than the rain itself. An explanation of the rainfall records will show how erroneous is the idea, held by many an easterner, that it rains all the time in Oregon. From the 15th of September to the 1st of November we have showers;

and the same from March 15th to May 15th. From November 1st to March 15th the rainfall is copious; not too excessive, nor of daily occurrence. Even in this period it will be clear for days, and sometimes weeks, together; the grass is green and growing, and it resembles the Eastern spring. From May 15th to September 15th we have occasional showers, but so few of these that this period is called the dry season.

"Along the Columbia river, from the Cascade mountains westward to the ocean; along the immediate coast and in the northern half of the Willamette valley, the annual rainfall amounts to from 42 to 70 inches, and in the other parts of the State it amounts to from 10 inches in eastern Oregon, to 35 inches in the southern part of the Willamette valley, and in the Umpqua valley; and from 8 to 25 inches in southern Oregon.

"From the Report of the Chief Signal Officer for 1886, it is found that along the Atlantic seaboard the annual rainfall amounts to from 48 to 68 inches; along the Gulf from 60 to 65 inches; along the Great Lakes from 30 to 52 inches; and in the Mississippi valley from 25 to 45 inches. A study of the rainfall in the various parts of the Union will show that many sections have as much and more precipitation than any place in Oregon. When the actual figures in the rainfall of Oregon and other States are known, Oregon can no longer properly be called the 'land of the dripping rain.'"

In the notes and crop reports we find Roseburg reporting ripe strawberries on April 14th. The highest and lowest temperatures were not far apart geographically. Ashland reporting 87° F. and Fort Klamath 18°. Frosts were not rare in April, and hail was reported from two stations during the month. Oregon is especially successful in its apples and its hops, and we note that the observer at Newport says that the latter grew 20 feet in April. Walla Walla reports a marked increase of rain since 1861,—not an undesirable thing in eastern Oregon, which is dry.

More detailed information can be obtained of the Oregon climate from a thick pamphlet published by the State board of

agriculture, and entitled "The Resources of the State of Oregon," a copy of which was sent us by Mr. Pague. This quarto pamphlet contains matter enough to fill a two volume octavo book, and is moreover accompanied by a good map of the State. Pages 39 to 59 are devoted to a consideration of the climate of the State, with profuse tables of annual and monthly summaries and means. We believe the pamphlet can be obtained on application to B. S. Pague, at Roseburg, or to the State board of agriculture at Portland.

POPULAR SANITARY LITERATURE.—Until recently sanitary writings have been easily divisible into two distinct classes,—one severely scientific, technical, accurate, and exhaustive, but generally unintelligible to any but specialists who had devoted much study to sanitary matters. These works are valuable to students, but they are caviare to the multitude. On the other hand the books on hygiene belonging to the popular class were generally inaccurate as to facts and absurd as to inference, and much harm has been done by the false doctrines spread by them.

The American Public Health Association, a voluntary organization, comprising in its ranks physicians, clergymen, teachers, engineers, manufacturers,—in fact, intelligent men and women of all classes,—has labored for years to correct the evils growing out of the old order of things, and to bring home to the people the sort of knowledge that is needed to save life and avert disease. Heartily aided by the press, the Association has done much good work at its annual meetings held in different parts of the country. Still, only a small proportion of the people could be reached in this way. Three years ago, however, a philanthropic member of the Association, Mr. Henry Lomb, of Rochester, offered prizes for essays upon certain topics of vital interest to every intelligent person having any regard to the preservation of life and health. The subjects selected and the successful competitors for the prizes are as follows: (1) Healthy Homes and Foods for the Working Classes, 62 pages, by Prof. V. C. Vaughan, of the University of Michigan; (2) The Sani-

tary Conditions and Necessities of School Houses and School Life, 36 pages, by Dr. D. F. Lincoln, of Boston; (3) Disinfection and Individual Prophylaxis against Infectious Diseases, 40 pages, by Major G. M. Sternberg, Surgeon U. S. Army; and (4) The Preventable Causes of Disease, Injury, and Death in American Manufactories and Workshops, and the Best Means and Appliances for Preventing and Avoiding Them, 19 pages, by Mr. George H. Ireland, of Springfield, Mass.

Although the treatment of the subjects in these essays is popular in tone, and easily understood by any one, the teaching is sound and thorough. There are no misstatements of fact and no false inferences contained in them, and while the most rigid scientific demands for accuracy are complied with, the whole matter is made clear and comprehensible to the most ordinary understanding.

THE WORK OF NEW ENGLAND METEOROLOGICAL SOCIETY.—This Society was organized for two closely allied purposes: the advance of the science of meteorology, and the promotion of a popular interest in its study. In carrying out these objects, it holds three public meetings each year, on the third Tuesdays of October, January and April, at which papers upon meteorological topics of general interest are presented. It also engages in active meteorological work in the following ways:

(1) The securing of regular observations throughout New England, especially of precipitation and temperature. Efforts are continually made to secure accuracy and uniformity in the records, that they may furnish reliable data for subsequent study. Rain gauges are manufactured for the Society, and thermometers as well as guages are tested for observers free of cost.

(2) The prompt publication of a monthly bulletin, containing a summary of the observations, and a description of the leading phenomena of the month, with other items of interest.

(3) The undertaking of special investigations, as opportunity offers.

Since the organization of the Society in June, 1884, it has

steadily prosecuted the work thus outlined. The Bulletin has been regularly issued, commencing with November, 1884, and at the beginning of the year 1888 contains reports from about 160 coöperating observers. Among the special investigations have been the following:

(1) An investigation of the phenomena of thunder-storms. The results of this study for the year 1885 have been published in the Proceedings of the American Academy (Boston) for 1886. The data collected in the summers of 1886 and 1887 are now being prepared for publication. A special corps of observers, numbering in 1887 nearly 500, coöperated in this work.

(2) A study of the phenomena attending the sea-breeze in the summer months. This was begun in 1887 and is now under discussion.

(3) An investigation of the distribution of precipitation in cyclonic storms. The results of this study up to July, 1886, have been published in the AMERICAN METEOROLOGICAL JOURNAL.

(4) A study of the remarkable heavy rainfall of February 10–14, 1886, and the consequent disastrous floods in southern New England, published in *Science*, and as a supplement to the Bulletin of the Society for that month.

Beginning with 1888, the work of the Society is carried on in coöperation with the Observatory of Harvard College. By this arrangement, a portion of the observations collected are to be published in the Annals of the Observatory, thus ensuring greater permanency. The Bulletin is issued regularly as before, but in a different form, and contains the permanent matter which will later be published in the Annals of the Observatory, together with other items of more transient interest.

The resources of the Society for the prosecution of its work are derived in several ways. As it acts as the local weather service in New England, it receives the generous assistance accorded to State Weather Services by the U. S. Signal Service. This includes the assignment of a member of that corps to constant duty, the franking privilege and other favors, but no direct financial aid. For the carrying on of its special

investigation, grants of funds have been made by the Trustees of the Bache fund of the National Academy and of the Elizabeth Thompson fund. For the equipment of stations in special localities, the Society is indebted to the Appalachian Mountain Club, the Observatory of Harvard College, and private individuals. The current expenses, however, including the cost of the Bulletin, have been met from the general treasury, and as the membership fees are insufficient, recourse have been had to special subscriptions. The State Weather Services usually receive appropriations from their respective states, and as this Society receives no such appropriation, though it does the same work, its financial burden is a heavy one.

The Society needs the coöperation of all persons in New England who are interested in its objects, and it invites its friends to aid it. The following are some of the ways in which this aid may be given:

(1) By membership in the Society. All members receive the monthly Bulletin free, and such other publications as may be prepared from time to time. The membership fee is $3.00 per year. The greatest need of the Society at present is funds for its *current* work. It has been found possible heretofore to secure funds for special investigations, but in no case can these funds be diverted to the current work, for which, therefore, the membership fees are the main reliance.

(2) By subscription to the Bulletin. The Bulletin is furnished without charge to members and coöperating observers, and can also be obtained at an annual subscription price of $1.00. Subscription should be sent to the treasurer and may begin with any month. Copies of the Bulletin from the beginning of publication can be obtained at the above rate (or $3.00 for Nos. 1-38, inclusive), but the earlier issues are nearly exhausted.

(3) By aiding in the current or special observations. A difficulty is experienced in procuring observers in localities where observations are greatly needed, because each observer is obliged to buy his own instruments. Friends of the Society can do no better service for this part of the Society's work than by furnishing the funds for equipping a station. A reliable observer

can in all cases be found. $12.00 will furnish a station with a reliable guage and a set of standard thermometers.

The affairs of the Society are managed by a council elected at the annual meeting. The members of the council are all actively engaged in other work, and give their services to the Society, as they find opportunity. The council invites all friends of the science of meteorology in New England to aid its work, and will cordially welcome any suggestion regarding the prosecution of the enterprise.

DR. FERRARI'S WORK.*—Dr. Ferrari's contributions to our knowledge of thunderstorms are among the most important of the numerous writings on this subject.

Number One of the papers given here contains a discussion of the results of the thunder-storm observations for 1882–83; the conclusions made by the author; a list of the stations and giving the total number of thunder-storms for each station during the years of observation; number of thunder-storms occurring on each day of the year, 1882–83, with totals for each month; the number of the different provinces for each month, and annual amount for the years 1882–83; the ten plates contain 73 charts and graphical tables, and an index to these. The charts are particularly good and add greatly to the value of the work; they show the atmospheric conditions and the progress of the storms for a few selected thunder-storms of 1882 and 1883, and are the most complete graphical portrayal of this phenomenon that the reviewer has seen. Italy is particularly well adapted for investigations of the *vertical* distribution and conditions of thunder-storms, and Dr. Ferrari has done a great service for meteorology by his investigations of these storms at various levels above the sea.

---

*1. Risultati Ottenuti Della Ricerclie del Dr. Ciro Ferrari Sulle Osservazioni dei Temporali reccolte nee 1882 to 1883, pp 77 (with 10 plates). From the "Annali dells Meteor. Ital." Vol. VII, Parte I, 1885.

2 Beiträge zur Gewitterkunde von Dr. Ciro Ferrari (translated from the Italian by Dr. Mantel). Pp. 26. From the *Meteorologische Zeitschrift*, 1888.

3. "Adamento Tipico dei Registratori Durante un Temporale," by Dr. C. Ferrari. Pp. 14. From the *Annali della Meteorologia Italiana*. Part I, 1885.

Number Two of these papers is a translation of the most important parts of the Italian paper, on the thunder-storms of 1882–83, and may be considered a continuation of the former paper published in the *Meteorologische Zeitschrift* (1885, p. 353–375).

During the year 1882 the number of single observations made was 12,519, and in 1883 the number was 11,937, but the total number of observations used in the discussion was 8,855, the number of days being 62.

The thunder-storms coming from the west had the greatest velocity; those from the east move less rapidly. The following little table shows the limits of velocities in kilometers per hour for the octants:

N.	NW.	W.	SW.	S.	SE.	E.	NE.
14–50.	21–69.	17–65.	26–46.	25–29.	——	22–29	27–31.

The greater the velocity of translation of the thunder-storm, the greater the force of the accompanying wind. The electrical strength is greater in the swifter moving storms. It appears that the greater the velocity the less the period of duration. It is probable that thunder-storms accompanied by damaging hail-fall possess a greater velocity than others. The originating place of a thunder-storm is some point from which it goes out radially, not toward all sides, but toward some one side, its earlier limits being sector like, gradually changing into streaks.

The principal conditions for thunder-storm formation seem to be high temperature in connection with high vapor tension. Dr. Ferrari finds that the relations formerly expressed as existing between the thunder-storms and the distribution of temperature and air pressure, hold good through the strata from the sea level to the highest regions from which we have observations. (We hope to refer to this matter more fully at another time).

The typical march of the registrations on self-registering apparatus at various elevations is discussed in Number Three, but the results are also given in number two. The stations chosen were Berne (573 m.), Santis (2,500 m.), Rome (50 m.).

This march he expressed as follows: Before the thunder-storm the pressure and relative humidity fall and the temperature rises in such a manner that the two former reach the minimum, and the latter the maximum, at the time of the beginning of the thunder-storm; after this the pressure and relative humidity rise rapidly and the temperature falls, the two former often reach a maximum and the last a minimum, at the end of the thunder-storm.

The march of the temperature is the reverse of that of the relative humidity and pressure. The wind velocity is small, or nearly zero before the thunder-storm, increases rapidly with its entrance, and reaches a maximum at the close of the storm or shortly after, and then sinks rapidly again. The usual form of the thunder-storm depression is that of an ellipse whose greatest axis is perpendicular to the axis of the thunder-storm. The temperature depression which follows a thunder-storm has likewise an elliptical form, having the greatest axis perpendicular to the axis of the thunder-storm. The prevailing wind blows in the direction of progress of the thunder-storm. A maximum of vapor tension precedes the thunder-storm and a minimum follows it. The great thunder-storm activity of the early afternoon hours is due to small local storms of this class; if only the storms of long continuance (nine hours or so) are counted, the difference is very small for the different hours of the day. The Isohyeten have the form of ellipses on the region passed over by a thunder-storm, and the longer axes are nearly parallel to the axis of the thunder-storm. In the thunder-storm path the hail regions are arranged in small strips in the direction of storm motion.

This paper (number two) well deserves to be translated in full into English. F. WALDO.

WEST INDIAN HURRICANES.—July is the first of the four hurricane months; and although these dangerous storms are far more liable to be encountered during August, September, and even October, yet every careful navigator will now shape his course with reference to their well known tracts, and, if obliged to tra-

verse regions where they frequently occur, will keep a sharp lookout for the earliest signs of their approach.

West Indian hurricanes, the name by which tropical cyclones in the North Atlantic are generally known, occur most frequently during the summer months, the maximum being reached between the middle of August and the middle of October. They seem to have their origin, as a general rule, about the northern edge of the belt of equatorial rains and calms, to the eastward of Windward islands. Starting as a whirl-wind on a gigantic scale, they at first move bodily westward, sometimes crossing the gulf of Mexico and reaching the coast of the United States with destructive violence, but more often curving to the northward and northeastward, following up the Gulf stream toward Newfoundland and circling around the area of high pressure over the mid-Atlantic. Fortunately for sailors the direction of rotation of the wind, which is drawn into and rushes furiously around the area of low barometer in one of these cyclones, is always the same, being in the Northern Hemisphere, invariably against the hands of a watch, as you look at a watch laid down with the face up; this direction of rotation is also described by the well known nautical phrase, "against the sun." But the early indications of an approaching hurricane are now so well understood that every effort should be made to avoid these dangerous regions altogether. The following brief résumé may therefore be studied to advantage, and the information utilized so far as possible in shaping a course to avoid the central regions of the storm, where fierce squalls and heavy seas often make it dangerous for any vessel, even a high-powered steamship, to manœuvre in such a way as to run out of the storm.

Hurricane Regions.—The tropics north of the 10th parallel and west of the 40th meridian; the Caribbean sea, Gulf of Mexico, and a broad belt curving northwestward from about St. Thomas and including the entire region from the Bermudas to the Atlantic coast of the United States and the British provinces. Further to the northeastward, these storms gradually lose their distinctive character, although their paths can be clearly followed across the Atlantic towards northern Europe.

Earliest Indications.—Barometer above the normal, and continuing so quite noticeably for several days, with dry, fresh, fair weather, and uncommonly transparent atmosphere. The formation, in increasing quantities, of light, feathery, cirrus clouds, and the setting in of a long, low, ocean swell from the direction of the approaching hurricane. The long lines, or filaments, of cirrus clouds also often indicate the bearing of the storm-center while it is still hundreds of miles away, as they radiate from it on every side. As the cirrus clouds gradually thicken, halos begin to appear about the sun and moon, and the ocean swell increases.

Unmistakable Signs.—As the sky becomes overcast with a light veil of cirrus clouds, with halos and rings about the sun and moon, the barometer begins to fall, slowly but steadily. The atmosphere loses its pleasant freshness, and seems very heavy, hot and moist. Dark red and violet tints are seen at the rising and setting of the sun, deepening in intensity day by day. Soon the cloud bank of the hurricane appears, like a distant mountain range, on the horizon, the barometer falls more rapidly, the wind freshens, and the first nimbus and cumulus clouds appear, with light squalls and passing showers.

Brief Rules for Action.—As the barometer falls, note very carefully the changes of the wind, watching the movement of the low clouds and scud rather than that of the surface wind itself. At first it will be safe to assume that the storm-center bears fully ten points to the right of the wind, but as the storm gets nearer and the wind has increased to a moderate gale the 8-point rule becomes a good guide, and the Storm Card may be referred to. If the wind remain steady as it freshens, you are on the track of the storm; square away and run before the wind, note the course and keep it, or, if obliged to heave-to, do so on the port tack. If the wind shift to the right, you are in the dangerous semi-circle; put the ship on the starboard tack, carry sail if possible, or heave-to on the starboard tack. If the wind shift to the left, you are in the navigable semi-circle; bring the wind on the starboard quarter and keep your compass course, if possible, if not, heave-to on the port tack.

General Size and Velocity of Progression.—The diameter of the area covered by such a storm system, including the outer region where the barometer is above the normal, may be as great as 1,000 miles; the true storm area, however, is very much smaller, especially in the tropics, the diameter in the cloud ring averaging only about 500 miles, and that of the region where the wind is blowing a gale, only about 300. The westward movement of the entire storm averages, in low latitudes, about 17 miles an hour; between the 25th and 35th parallels, where the storm track is curving to the northward and eastward, its velocity is considerably less; and as the storm moves off to the northeastward its velocity generally increases to 20 miles an hour, or even more. There is such a large amount of variation in the size and velocity of these storms, however, that little confidence can be placed in such general averages, so far as any practical use is concerned.—*Pilot Chart* for July.

Royal Meteorological Society.—The usual monthly meeting of this Society was held on Wednesday evening, the 15th of April, at the Institution of Civil Engineers, 75 Great George Street, Westminster; Dr. W. Marcet, F. R. S., President in the chair.

Dr. T. E. Hale, B. A., V. C., Mr. R. Lawson, LL. D., F. S. S., and Mr. S. Walker, were elected Fellows of the Society.

The following papers were read:

(1) "Jordan's new pattern Photographic Sunshine Recorder," by Mr. J. B. Jordan. The improvement in this instrument over the previous pattern of Sunshine Recorder consists in using two semi-cylindrical or D-shaped boxes, one to contain the morning and the other the afternoon chart. An aperture for admitting the beam of sunlight is placed in the centre of the rectangular side of each box so that the length of the beam within the chamber is the radius of the cylindrical surface on which it is projected, its path therefore follows a straight line on the chart at all seasons of the year. The semi-cylinders are placed with their faces at an angle of 60° to each other. They are fixed on a flat triangular plate which is hinged to a suitable

stand having levelling screws attached and fitted with a graduated arc as a means of readily adjusting and fixing the cylinders to the proper vertical angle agreeing with the latitude of the station where used.

(2) "On the Meteorology of Southeastern China in 1886," by Dr. W. Doberck, F. R. Met. Soc. This paper gives the results of Observations made at the Custom Houses and Lighthouses by officers of the Imperial Chinese Maritime Customs. In summer there is very little change of temperature with latitude. The temperature depends upon the distance from the nearest sea coast, and is greatest at stations farthest inland. The highest mean temperature occurred in July and the lowest in January. The Northeast Monsoon blows from September to June, and the South Monsoon during July and August. The latter does not blow with half the force of the former. Rainfall is greatest in Northern Formosa and least in Northern China. Along the east coasts of Formosa and Luzon the winter is the wet season, while in China, July seems to be the wettest month of the year.

(3) "Lightning in Snowstorms," by Prof. A. S. Herschel, F. R. S.

(4) "Insolation," by Mr. Rupert T. Smith, F. R. Met. Soc.

THE usual monthly meeting of this Society was held on Wednesday evening, the 16th of May, at the Institution of Civil Engineers, 25 Great George Street, Westminster; Dr. W. Marcet, F. R. S., President, in the chair.

Mr. L. W. Gatward and Mr. N. Simmons were elected Fellows and Prof. D. Colladon an Honorary Member of the Society.

The following communications were read:

(1) "Report of the Wind Force Committee on Experiments with Anemometers conducted at Hersham," by Mr. G. M. Whipple, B. Sc., and Mr. W. H. Dines, B. A. A whirling apparatus with arms of 29 feet radius was rotated by means of a small steam engine. On the arms of the whirler four different anemometers were placed. Each experiment lasted fifteen minutes, the steam pressure remaining constant during the run. For Kew Standard Anemometer, with arms 2 feet long, the ex-

periments give a mean value for Robinson's factor of 2.15; and for two smaller instruments, the factor is 2.51 and 2.96. Mr. Dines's Helicoid Anemometer gave very satisfactory results, the mean factor being 0.996.

(2) "On the measurement of the increase of Humidity in rooms by the emission of Steam from the so-called Bronchitis Kettle," by Dr. W. Marcet, F. R. S. The author described a number of experiments which he had made by steaming a room with a Bronchitis Kettle, and ascertaining the rise and fall of the relative humidity from readings of the dry and wet bulb thermometers. He found that the air in the room could not be saturated, the relative humidity not exceeding 85 per cent.

THE concluding meeting of this Society for the present session was held on Wednesday evening, the 20th of June, at the Institution of Civil Engineers, 25 Great George Street, Westminster, Dr. W. Marcet, F. R. S., President, in the chair.

Mr. F. de B. Collenette, F. R. C. P., M. R. C. S., Mr. Ewart, M. R. C. S, Mr. F. A. Velschow, and Mr. J. T. Wells, F. R. G. S., were elected Fellows of the Society.

The following papers were read:

(1) "First Report of the Thunderstorm Committee." This report deals with the photographs of lightning flashes, some 60 in number, which have been received by the Society. From the evidence now obtained it appears that lightning assumes various typical forms, under conditions which are at present unknown. The committee consider that the lightning flashes may be arranged under the following types: 1, Stream, 2, Sinuous, 3, Ramified, 4, Meandering, 5, Beaded or Chapletted, and 6, Ribbon Lightning. In one of the photographs there is a *dark* flash of the same character as the bright flashes, but the committee defer offering any explanation of the same until they get further examples of dark flashes. As the thunderstorm season is now coming on, the committee propose to publish their report at once, along with some reproductions of the photographs by the autotype process, in order that observers may be prepared to notice the various forms of lightning.

(2) "The cold period from September, 1887, to May, 1888," by Mr. C. Harding, F. R. Met. Soc. The mean temperature for each of the nine months from September, 1887, to May, 1888, was below the average, whilst in the case of October there has been no corresponding month as cold during the last half century, and only three colder Aprils. In London the mean temperature for the period was only 42.4°, and there has been no similarly low mean for the corresponding period since 1854–5, which will be remembered as the time of the Crimean war, and only three equally cold periods during the last 50 years. The temperature of the soil at Greenwich at three feet below the surface was below the average in each month from October to April; in October and April the temperature at this depth was the coldest on record, observations being available for the last 42 years, and in November it was the coldest for 37 years.

(3) "Observations on Cloud Movements near the Equator, and on the General Character of the Weather in the 'Doldrums,'" by Hon. R. Abercromby, F. R. Met. Soc. The author gives the results of observations made during four voyages across the equator and the "Doldrums," with special reference to the motion of clouds at various levels. Two voyages were across the Indian Ocean during the season of the Northwest Monsoon, and two across the Atlantic in the months of July and December. The nature of the general circulation of the atmosphere near the "Doldrums" is discussed as regards the theory that the Trades, after meeting, rise and fall back on themselves, or, according to the suggestion of Maury, that the Trades interlace and cross the Equator, or as following the analogy of Dr. Vettin's experiments on smoke. It is shown that the materials at present available are insufficient to form a definite conclusion, but details are given of the general character of the weather and of the squalls in the "Doldrums," with a view of showing what kind of observations are required to solve this important problem. The old idea of a deep Trade—with a high opposite current flowing overhead—is certainly erroneous; for there is always a regular vertical succession of the upper currents as we ascend, according to the hemisphere.